

ON THE ANATOMY OF *TAGELUS GIBBUS* AND *T. DIVISUS*.

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PLATE XIX.

I DESIRE first of all to thank Professor W. H. Dall, of the United States National Museum, for so kindly allowing me to examine the following specimens:—

TAGELUS GIBBUS (Spengler).

External Characters.—The animal measures from the anterior side of the anterior adductor muscle to the posterior side of the posterior adductor muscle 48 mm. and is 19 mm. deep. It curves a little dorsally along the dorsal surface, and laterally is slightly constricted. Separately the mantle-lobes (Fig. 1, *M.L.*) project a little dorso-anteriorly from the anterior adductor muscle, and passing around the mantle edges it is observed that they are curved anteriorly, and there is no concrescence of the apposed surfaces until a position directly ventral to the posterior adductor muscle is reached, which also marks the great extent of the pedal aperture. Between this point of concrescence and the posterior adductor muscle the mantle edges are not again concresced. At the junction of the mantle-lobes, ventrally to the posterior adductor muscle, is the musculus cruciformis (Fig. 1, *M.C.*), the terminations of which are on each side, situated equally, though some distance, apart. The proximal portion of the siphon (Fig. 1, *Ex.S.* and *In.S.*) commences close to the posterior adductor muscle, but soon takes a deep bend inwardly, so that the central part lies ventrally to the retractor pedis posterior muscle. It then returns and ends above the musculus cruciformis. Along the antero-lateral margin the siphon is coalesced with the inside walls of the mantle-lobes, thereby completely enclosing the posterior part of the pallial cavity, with the exception of the siphonal apertures. The mantle-lobes extend a considerable distance posterior to their fusion with the proximal portion of the siphon, and are capable of enveloping the greater part of the free siphonal tubes (Fig. 1, *P.L.P.*). The latter are long and separate, the exhalent (Fig. 1, *Ex.S'*) being longer than the inhalent one (Fig. 1, *In.S'*). They have thick walls and are very muscular. Internally they are ribbed longitudinally and transversely, the transverse ribbings being very close together. The retractor siphonal muscles (Fig. 1, *S.R.M.*) are short and thick, and soon spread out into an oblong-ovate-shaped body, and from a large surface adhere to the valves of the shell.

When contrasted with *Tagelus rufus*¹ it will be observed that in

¹ "The Anatomy of *Pharella orientalis*, Dunker, and *Tagelus rufus*, Spengler": Journ. Malac., vol. x (1903), p. 114.

Tagelus gibbus the mantle-lobes are much more muscular, while those portions of them posterior to the posterior adductor muscle are not so deep; the free siphonal tubes, though larger and more muscular, are shorter, and the central part of the proximal portion of the siphon is situated more posteriorly; the posterior part of the anterior adductor muscle is comparatively larger, but both portions of the muscle are of the same depth. In *T. rufus* the anterior is deeper than the posterior part, but the division by the ventral integument passing between the two parts is not so marked; the posterior adductor muscle is smaller; the foot is more muscular; the free portion of the pedis retractor posterior muscle is shorter and thicker, and the distal ends of its bifurcations rest on the antero-dorsal surface of the posterior adductor muscle instead of being united with the anterior side as they are in *T. rufus*.

Compared with *Solecurtus Dombeyi* (Lam.),¹ it will be seen that in *T. gibbus* the mantle-lobes, anterior to the siphon, are about as muscular, whilst the proximal portion of the siphon is not nearly so muscular, and the free portions of it do not appear to possess the power of inversion like those of *S. Dombeyi*; the depth of the anterior adductor muscle is not so great, nevertheless the posterior portion is larger; the foot is not nearly as large or as muscular; the free portion of the pedis retractor posterior muscle is much longer, and the posterior part of the animal is also much longer.

It will thus be inferred from the foregoing that *T. gibbus* possesses some of the characters of both *T. rufus* and of *S. Dombeyi*, but anatomically lies nearer the latter than the former species.

Pallial Muscles.—The muscles of the pallial edge commence at the anterior adductor muscle as a deep band and gradually diminish in depth as they proceed posteriorly.

The anterior adductor muscle (Fig. 1, *A.A.*) is a muscle of even depth, being about three times as long as deep, with the anterior part slightly curved ventrally. The smaller posterior part is separated from the anterior by the ventral muscular integument passing between them. The muscle is connected anteriorly with the mantle-lobes, and posteriorly with the body-covering and retractor pedis anterior muscles.

The posterior adductor muscle (Fig. 1, *P.A.*) is an ovate-shaped muscle connected anteriorly with the body-covering and the bifurcated ends of the retractor pedis posterior muscle, and posteriorly with proximal portions of the siphon and mantle-lobes.

The musculus cruciformis (Fig. 1, *M.C.*), as before stated, is situated ventrally to the posterior adductor muscle. The united portion is thick and short, with the four distal ends of nearly equal length.

The branchial retractor muscles are present, but less prominent and not so well developed as those of *Solecurtus strigillatus*.

Pedal Muscles.—The foot (Fig. 1, *F.*) is deep, short, and very muscular. The general appearance shows it to consist of numerous

¹ "On the Anatomy of certain Species of Solenidae": op. cit., vol. xii (1905), p. 78.

bundles of longitudinal muscles with a large number of transverse ones, the whole encased in a muscular integument.

The retractor pedis anterior muscle is not very long or bifurcated, and on reaching the proximal portion of the foot its fibres run chiefly posteriorly and internally to the longitudinal muscles.

The retractor pedis posterior muscle is very long, and the distal ends of the bifurcated portions rest on the antero-dorsal surface of the posterior adductor muscle.

The protractor pedis muscles are very short, and lie close to the retractor pedis anterior muscles.

There is some slight indication of the presence of weakly developed elevator pedis muscles.

Alimentary Canal.—The wide mouth (Figs. 2 and 3, *M.*) points anteriorly with the lips (Figs. 2 and 3, *A.L.* and *P.L.*), projecting forwards. The œsophagus (Figs. 2 and 3, *Oe.*) is very short, and quickly opens into the stomach. The stomach is comparatively large, the posterior being larger than the anterior portion. The division of it into distinct parts is well defined on the left side, but on the right side is only traceable with difficulty. On the left side, the œsophageal division (Fig. 2, *Oe.St.*) is small, and separated from the central (Fig. 2, *C.D.*) and cardiac (Fig. 2, *C.St.*) divisions by muscular ridges. Posterior to the œsophageal division lies the central division, and above the central division is the cardiac division, the latter being very small. The dorsal ridge of the central division is developed into a muscular papilla, the continuation of it extending nearly across the stomach (Figs. 2 and 3, *M.P.*). From the dorsal side of the papilla runs another muscular ridge separating the cardiac from the posterior division. The pyloric division (Figs. 2 and 3, *P.St.*) occupies the remaining, and larger, portion of the stomach. Where the cæcum of the crystalline style (Figs. 1, 2, and 3, *C.C.*) leaves the pyloric division on its ventral side it is very large, but soon tapers to a diminished size, and then passes with a curve to the dorsal part of the pedal cavity about the centre of the foot. At the junction of the cæcum of the crystalline style and the stomach is a raised muscular ridge. The crystalline style itself extends all along the cæcum and the centre of the stomach to the anterior part. The intestinal wall (Fig. 3, *In.*) is fused with that of the cæcum of the crystalline style, and appears as a groove on the right side of the latter, but near the distal end of the cæcum is quite entire (Fig. 1, *In.*). The intestine afterwards returns along the right lateral side of the cæcum for some distance, when, becoming free, proceeds with a curve to the posterior side of the pyloric division, where it forms a large number of folds, and, bending posteriorly, passes over the posterior adductor muscle into the exhalent siphonal chamber (Fig. 1, *A.*). The liver (Fig. 1, *L.*) covers the stomach with the exception of the dorsal surface at the anterior end.

Nervous System.—The cerebro-pleural ganglia are situated on each side, a little anterior to the mouth, and are connected by a commissure passing in front of it.

The visceroparietal ganglia are situated underneath the bifurcated

parts of the retractor pedis posterior muscle, a position anterior to the posterior adductor muscle. The branchial nerve takes a deep bend anteriorly before reaching the gills.

The pedal ganglia are situated between the transverse pedal muscles close to the cæcum of the crystalline style, but some little distance anterior to the distal end of it.

TAGELUS DIVISUS (Spengler).

The animal measures from the anterior side of the anterior adductor muscle to the posterior side of the posterior adductor muscle 25 mm., and is 11 mm. deep. Dorsally it is curved outwardly, but along the ventral surface is nearly straight. The mantle-lobes (Fig. 4, *M.L.*) are connected with the anterior side of the anterior adductor muscle, whence they first outline a large anterior curve, and afterwards pass posteriorly in nearly a direct course, until a position almost ventral to the posterior adductor muscle is reached before the marginal parts are joined together, thus denoting the great extent of the pedal aperture. The foot (Fig. 4, *F'*) is comparatively larger, deeper, and more muscular. In the single specimen under examination it lies in an antero-ventral direction, but whether this is its natural resting position is doubtful, as there is some indication of more than normal tension of the muscles in and near the anterior region of the proximal portion of the foot; however, the fact that the range of the pedal aperture extends so far posteriorly in the different species of *Tagelus* and the presence and situation of certain pedal muscles point to the use of the foot in a ventral as well as an anterior plane of movement.

The proximal portion of the siphon (Fig. 4, *Ex.S.* and *In.S.*) is situated between the mantle-lobes, a little antero-ventrally to the posterior adductor muscle, whilst laterally it is united with the inside surface of each mantle-lobe, thus quite enclosing the posterior portion of the pallial cavity with the exception of the siphonal apertures. Behind this coalesced line the mantle-lobes (Fig. 4, *P.L.P.*) extend separately some distance posteriorly, so enabling them, when necessary, to completely envelop the free siphonal tubes (Fig. 4, *Ex.S'* and *In.S'*). The latter are separate from each other with the distal ends pointing dorsally, and, though somewhat contracted, they are relatively shorter than those of allied species. Anteriorly the proximal portion of the siphon continues on each side of the animal as a siphonal retractor muscle (Fig. 4, *S.R.M.*), which is short, thick, and rounded, but soon spreads out into an ovate-shaped body, and from the external surface adheres to the adjacent valve of the shell.

When contrasted with the other species of *Tagelus* it will be seen that *T. divisus* possesses quite distinctive characters. Its resemblance to *Solecurtus Dombeyi* is noticeable in the muscular mantle-lobes, the strongly developed muscular foot, the diminished length of the free siphonal tubes, and the power of the posterior parts of the mantle-lobes to completely envelop them, when necessary; but it differs from this and the other species in its greater depth, in the comparative largeness of the anterior and posterior muscles and of the musculus cruciformis, in the length of the retractor pedis posterior

muscle (which is much longer than that of *S. Dombeyi*, but shorter than that of either *T. rufus* or *T. gibbus*), and, as far as I have been able to ascertain from the specimens submitted to me for examination, in the possession of elevator pedis and protractor pedis muscles.

Pallial Muscles.—The muscles of the mantle-lobes (Fig. 4, *M.L.*) begin at the anterior end as a deep band, and lessen in depth as they proceed posteriorly.

The anterior adductor muscle (Fig. 4, *A.A.*), which lies inclined a little in an antero-ventral position, is a broad and deep muscle, curved dorsally, and gradually decreasing in depth towards the posterior side. It is connected anteriorly with the mantle-lobes and posteriorly with the proximal portion of the foot and body-covering. I cannot trace any complete division of it by the ventral integument passing between the anterior and posterior portions.

The posterior adductor muscle (Fig. 4, *P.A.*) is very deep, but shallows somewhat towards the posterior side. It is connected anteriorly with the body-covering and the posterior retractor pedis muscle, and posteriorly with the mantle-lobes.

The musculus cruciformis (Fig. 4, *M.C.*) is a broad transverse muscle situated ventrally to the posterior adductor muscle, near to the edge of the mantle-lobe. It appears to be in one piece, of nearly the same width and depth throughout, with its external surfaces adhering to the valves of the shell. There is a slight indication of the presence of the branchial muscles (Fig. 4, *B.R.*), which are attached to the shell a little behind the pedis elevator muscles.

Pedal Muscles.—As before stated, the muscles of the foot are very muscular, the muscularity reaching as far as the dorsal surface of the proximal portion of it.

The protractor pedis muscles (Fig. 4, *P.P.*) are short and situated posterior to, with the terminal parts a little over, the anterior adductor muscle.

The retractor pedis anterior muscles (Fig. 4, *P.R.A.*) are likewise short, and situated a little distance posterior to the protractor pedis muscles.

The elevator pedis muscles (Fig. 4, *E.P.*) are posterior, though nearer the median line, to the retractor pedis anterior muscles.

The retractor pedis posterior muscle (Fig. 4, *P.R.P.*) is a rounded muscle of medium length, with the distal end of it bifurcated, the bifurcations resting on the antero-dorsal edge of the posterior adductor muscle.

Alimentary Canal.—The lips (Figs. 4, 5, and 6, *A.L.* and *P.L.*) point antero-ventrally. The œsophagus (Figs. 5 and 6, *A.L.* and *P.L.*), which is of medium length, soon expands into the œsophageal division of the stomach (Figs. 5 and 6, *Oe.St.*). This division widens out posteriorly as far as what I have previously termed the muscular papilla (Fig. 5, *M.P.*). The anterior continuation of the latter projects laterally some considerable distance across the stomach, separating the cardiac (Fig. 5, *C.St.*) from the central (Fig. 5, *C.D.*) division, but both of these divisions are small. The pyloric division (Figs. 5 and 6, *P.St.*) is large, and continues as the cæcum of the crystalline style

